

Observations of the Spectra of Sun-spots in the Region B—D made at the Stonyhurst College Observatory in the years 1882–89.
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(Communicated by E. W. Maunder.)

(Abstract.)*

The paper contains the results derived from the detailed study of the spectra of ninety Sun-spots in the region B—D. The observations were made after the plan followed at Greenwich, and the instrument employed was the Browning automatic spectroscope, generally with a dispersion of twelve prisms of 60° attached to the 8-inch equatoreal.

In the discussion the observations are divided into two periods, the first embracing the disturbed period of solar activity from 1882 till the autumn of 1886; and the second, called the quiet period, that from the autumn of 1886 till June 1889.

The widening of the lines has, as far as possible, been reckoned in tenths of the normal breadth of the lines. For the sake of comparison of the observations among themselves, two standards have been chosen, and a line widened between the limits 0.5 and 1.0 of its normal breadth is called a "more widened line," and that widened 1.0 or more a "most widened line." Lines below 0.5 are simply "widened." A long table gives the mean widening of nearly three hundred lines between B and D, both for the disturbed and the quiet period. Any interesting points about the lines are noted in a column headed "Remarks."

The main conclusions deduced from the discussion of these observations may be summarised as follows:—

1. The general absorption due to a spot occasionally varies in intensity in different portions of the spectrum. Two or three times it has been so dark at the red end as to partially mask the selective absorption of the lines. The spot-bands observed in 1885 and the first half of 1886 have not been seen in any spot observed from the autumn of 1886 to the autumn of 1890.

2. Of fifty-three iron lines occurring in this part of the spectrum, in the disturbed period only one had a mean widening placing it among the more widened lines.

3. In a total of 1,228 observations, the large majority having been taken in the disturbed period, only three in the disturbed period, and fourteen in the quiet period, placed iron lines among the most widened lines.

4. In the quiet period many more iron lines appeared among the more widened lines than in the disturbed period. Comparing the totals, 126 observations in 1885, and 127 in 1889, only three times in the former year was iron among the more widened lines, against eighty-one times in the latter year.

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5. In general the iron lines seen bright in the chromosphere by Young have been least affected in Sun-spots.

6. There is a great variation in the lines of this metal which are selected for widening by Sun-spots, either by different spots, or by the same spot on different days and at different appearances.

7. Excepting four out of the eleven titanium lines in this part of the spectrum, the rest are very much affected in spots both at the maximum and the minimum epochs.

8. The lines most persistently affected are among the faintest of the Fraunhofer lines, and among the brighter of the metallic lines.

9. A characteristic of some titanium lines is that they are very marked in the spectrum of the penumbra of spots.

10. Only three lines of this element have coincident chromospheric lines, and two of these are among the least widened of the lines.

11. Including "basic" lines, or lines with the dispersion used common to two elements, of twelve lines of calcium observed, six have coincident bright lines in the chromosphere. While "basic" lines of calcium, which are coincident with bright lines, have been recorded among the most widened lines, simple calcium lines having coincident chromospheric lines have not entered into this class.

12. In the minimum period the mean widening of calcium has increased, but the general variation is not at all great.

13. Sodium, represented by four lines, which include the D lines, was very much affected in the large spots of the maximum epoch.

14. Lines of barium, nickel, and manganese have never entered among the most widened lines.

15. The short lines in the metallic spectra of barium and nickel have been more widened than the long lines.

16. Eleven "basic" lines occur in this region. In a total of 407 observations, only fifteen times have such lines been recorded among the most widened lines, and twelve of these instances are due to lines which have calcium as one component. Their appearance among the more widened lines is about 31 per cent.

17. With regard to lines of unknown origin, the following conclusions have been derived from 2,088 individual observations:—

- (a) About the maximum period a great number of faint lines not in Ångström are to be seen in Sun-spots.
- (b) Such lines are not seen exclusively in maximum spots, but reappear in minimum spots when they are large—*e.g.* in the fine spot of June 1889, and to a less extent in that of May 6 of the same year.
- (c) Some faint lines which have been persistently watched are to be seen greatly widened in every Sun-spot, large or small, whether in the disturbed or quiet period.

- (d) The mean widening of all the five bright chromospheric lines coincident with unknown lines in this region has been low.

18. The C line is generally, though by no means always, less dark or unaffected over Sun-spots. When reversed, the reversal has been generally due to the faculæ between the spots.

19. Several lines marked as "telluric" in Ångström's map have been widened in Sun-spots.

20. Taking all the observations together, the lines in this region might provisionally be arranged as affected in Sun-spots in the following order:—Lines of unknown origin, faint lines of titanium, lines of calcium, sodium, iron, barium, nickel, and manganese.

On the Correction of Micrometric Measures for Refraction.

By Harold Jacoby, B.A.

(Communicated by Dr. Gill.)

The following investigation was undertaken in consequence of a suggestion made by Dr. David Gill, H.M. Astronomer at the Cape of Good Hope. Dr. Gill pointed out to me that the reduction of stellar parallax observations would be much facilitated if the refraction correction were expressed in terms of the true distance and position angle, and the formulæ carried to a degree of approximation high enough for the accurate correction of large distances.

Modern micrometers are capable of measuring much greater distances than could be managed with Bessel's heliometer; and it is therefore necessary to retain certain terms in the development of the refraction which were rejected by Bessel as insignificant. It is hoped, however, that their retention will entail but little additional labour upon the computer, and that the numerical work will be considerably lessened by the use of the tables which I have computed. These tables will also be found quite convenient for the correction of distance and position angle measures made with the ordinary equatoreal; for it will then be sufficient to use Table I. for the mean refraction, and to apply a correction, depending on the state of the meteorological instruments, easily derived from Table II. The method of doing this will be explained further on. It is, of course, needless to add that the tables are also adapted to the correction of stellar parallax or other measures made by the photographic method.

I shall first examine the corrections necessary for distance measures. If we assume the following notation:—

δ_0, ζ_0 = the means of the true declinations and zenith distances of the stars observed.